GEOGRAPHY 2230A
REMOTE SENSING
Fall 2017

Course Information:

Lecture:	Monday	12:30 pm - 2:30pm	SSC 3026
Lab-003:	Tuesday	2:30 pm - 4:30pm	SSC 1316A
Lab-002:	Wednesday	2:30 pm - 4:30pm	SSC 1316A

Instructor Information:

Instructor: Chunhua Liao, PhD Candidate, Department of Geography
Contact: Office: SSC 2221; E-mail: cliao33@uwo.ca
Office hours: Monday 2:30 pm - 4:30 pm, or by appointments

Teaching Assistants:

Tuesday lab: Yang Song, PhD student. Office: SSC 2430; Email: ysong24@uwo.ca
Office hours: Tuesday 1:30 pm – 2:30 pm; 4:30 pm - 5:30 pm, or by appointments

Wednesday lab: Peter Crawford, Master student. Office: SSC 2430; Email: pcrawfo@uwo.ca
Office Hours: Wednesday 1:30 pm – 2:30 pm; 4:30 pm - 5:30 pm, or by appointments

Course Description:

Introduction to the principles, techniques, and geographic applications of remote sensing systems. Computer processing of remote sensing digital data. Interface of remote sensing data with geographic information systems.

Prerequisite(s): 1.0 course from Geography 1100, 1300A/B, 1400F/G, 1500F/G, 2131A/B, 2153A/B, or registration in a module in Science or in Engineering.
Adequate mathematical background is needed to be successful.
2 lecture hours, 2 laboratory hours, 0.5 course.

Prerequisite checking - the student's responsibility:

You are responsible for ensuring that you have successfully completed all course prerequisites, and that you have not taken an anti-requisite course. Lack of prerequisites may not be used as a basis for appeal. "Unless you have either the prerequisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites."

Required Text:

Lillesand, T.M., Kiefer, R.W. and Chipman, J.W., 2015, "Remote Sensing and Image Interpretation", 7th Edition, John Wiley & Sons. (ISBN : 978-1-118-34328-9 (print); 978-1-118-91947-7 (e-book)).

Recommended Readings:

Jensen, J.R., 2015, "Introductory Digital Image Processing – A Remote Sensing Perspective", 4rd Edition, Prentice Hall. (ISBN-10: 0-13-405816-X; ISBN-13: 978-0-13-405816-0)

Richards,A. J. 2013, "Remote Sensing Digital Image Analysis", 5th edition, Springer. (ISBN: 978-3-642-30061-5 (Print); 978-3-642-30062-2 (Online)).

Jensen, J.R., 2007. "Remote sensing of the Environment – An Earth Resource Perspective", 2nd edition, Prentice Hall. (ISBN 978-0-13-188960-7)

Method of evaluation:

Lab. Assignments (6 labs)	40%
Attendance and participation	5%
Class Presentation	10%
Midterm test (Mon., Oct.23, 12:30pm - 2:20pm, SSC 3026)	15%
Final exam	30%

Course Requirements:

1. Attendance and participation: Each student is required to attend all the lectures and labs. Attendance can be taken randomly during any lecture and lab session. Participation includes in class exercises (non-graded).

2. Exams: All students are required to take the close-book midterm test and final exam. During the tests, scientific calculators are permitted and no other electronic devices are allowed. There will be no make-up test for the midterm test. If you will miss the mid-term test under extreme circumstances, you must obtain permission from the Dean's office and provide sufficient documentation. When I receive the permission from the Dean's office, your final exam will account for 45%. If you miss the midterm with no good reason, you will receive no mark for the midterm. Make-up exams will be given for the final exam only under extreme circumstances. If you consider that you have grounds to write the final exam on an alternate date, you must follow the procedure established by the Dean's Office and complete the appropriate forms. You must obtain permission from the Dean's office and provide sufficient documentation, such as a Doctor's note. In addition, you must inform the instructor at least 2 days in advance before the final exam.

3. Lab assignments: You must attend all labs. You should observe all the due dates for assignments. Assignments are due during the lab hours of the assignment due dates. Plagiarism or copying is unacceptable. If there are two identical answers to a lab. or parts of the lab., both students will be given a mark of 0 for that lab. The penalty of a late assignment is 2^n percent of the maximum mark for the assignment, where n = number of days late. (i.e., If you are late one day, 2% off; two days, 4% off; three days, 8% off; four days, 16% off; five days, 32% off; six days, 64% off; seven days, 100% off).

4. Missed assignment will receive no mark. In case of extreme circumstances and you need accommodation of less than 10% of the total grade, the instructor may allow extension provided that you submit proper documentation. If you need accommodation of more than 10% of the total grade, you must obtain permission from the Dean's office and provide sufficient documentation.

5. "For UWO Policy on Accommodation for Medical Illness and a downloadable SMC see: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf Downloadable Student Medical Certificate (SMC): http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf Students seeking academic accommodation on medical grounds for any missed tests, exams, participation components and/or assignments worth 10% or more of their final grade must apply to the Academic Counselling office of their home Faculty and provide documentation. Academic accommodation cannot be granted by the instructor or department."

6. For both the exams and lab assignments, plagiarism or copying is unacceptable. Plagiarism is a major academic offence (see Scholastic Offence Policy in the Western Academic Calendar). Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

7. Required for Labs 4, 5 and 6: One or two USB memory key, or a portable hard drive for storing data and results. I suggest that you double backup your work on two USBs, in case one USB has problems. Please note: do not insert your USB with the data from the Windows system to a Mac computer, since this may cause errors on your data.

8. Each student will participate in a group presentation about remote sensing data (2 students per group). You will choose from a list of topics, conduct research and prepare a power point presentation.

9. Print credits: You will be given a limited number of free print credits for this course. If you need, you may purchase more credits for printing using the B/W laser printer(s) and colour laser(s) printer in the SDAL lab. So make sure you check your print balance often. Consult your TAs for details.

Additional information:

*Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 (*http://www.sdc.uwo.ca/*) for any specific question regarding an accommodation*.

If you or someone you know is experiencing distress, there are several resources here at Western to assist you. Please visit http://www.uwo.ca/uwocom/mentalhealth/ for more information on these resources and on mental health.

Lab assignments:

Lab 0 Fundamentals of Remote Sensing (optional)
Lab 1 Remote Sensing Field Work (7%)
Lab 2 Anaglyph 3D and Photogrammetry (7%)
Lab 3 Introduction to digital images (5%)
Lab 4 Digital image processing using PCI Geomatica (7%)
Lab 5 Image classification I using PCI Geomatica (7%)
Lab 6 Image classification II using PCI Geomatica (7%)

Topics and Readings

1 Introduction to Remote Sensing

Readings: *Lillesand and Kiefer, (7th Ed.): Chapter 1, pp. 1-58.*
(Lillesand and Kiefer, (6th Ed.): Chapter 1, pp. 1-51.)

- Remote sensing
- Electromagnetic radiation (EM wave, Stefan-Boltzmann Law, Wien's Displacement Law)
- Data acquisition (energy source, the atmosphere, energy interactions at the Earth's surface, the sensor)
- Data analysis (data interpretation, information products, applications).
- Field measurements - ASD spectrometer

2 Aerial analog / digital images and Photogrammetry

Readings: *Lillesand and Kiefer, (7th Ed.): Chapter 2, pp. 85-145 3, pp.146-217.*
(Lillesand and Kiefer, (6th Ed.): Chapter 3, pp.123-188.)

- Introduction
- Stereoscopy with aerial photographs
- Photo scale
- Relief displacement
- Image parallax
- Height measurement

3 Digital Image Processing - Image Enhancement

Readings: *Lillesand and Kiefer, (7th Ed.): Chapter 7, pp.485-537.*
(Lillesand and Kiefer, (6th Ed.): Chapter 7, pp.482-545.)

- Digital image concept
- Contrast manipulation (linear stretch, histogram equalization)
- Spatial feature manipulation (low pass filters, high pass filters)
- Multi-image manipulation (false colour composites, Principle Components Analysis)

4 Digital Image Processing - Image Classification

Readings: *Lillesand and Kiefer, (7th Ed.): Chapter 7, 537-608.*
(Lillesand and Kiefer, (6th Ed.): Chapter 7, 545-610.)

- Supervised classification (minimum-distance-to-means classifier, parallelepiped classifier, maximum likelihood classifier)
- Unsupervised classification (k-means clustering)
- Accuracy assessment

5 Remote sensing image interpretation and applications

Readings: *Lillesand and Kiefer, (7th Ed.): Chapter 1, pp.59-84; Chapter 8, pp. 609-698.*
(Lillesand and Kiefer, (6th Ed.): Chapter 4, pp. 189-323.)

- Land use/land cover mapping
- Agricultural applicatinon
- Forestry application
- Water resource application
- Urban application
- Terrain analysis; Geologic/Geomorphic application

6 Remote sensing case studies

7 Satellite Imagery (Student Presentations)

Readings: *Lillesand and Kiefer, (7th Ed.): Chapters 4, pp. 218-282; Chapter 5, 283-382; and Chapter 6, 385-484 .*
(Lillesand and Kiefer, (6th Ed.): Chapters 6 and 8, pp. 392-481; 626-726.)

Additional readings (search by students)

- Landsat satellites; SPOT satellites; ASTER, IRS, etc.
- Fine resolution land satellites (IKONOS-2, Quickbird, etc.)
- Hyperspectral satellite systems (MODIS, CHRIS/PROBA, Hyperion, etc.)
- Radar satellites (ERS-1, ENVISAT, RadarSat, etc…)
- Meterological satellites (NOAA AVHRR, etc)
- and more ...

Tentative Lecture/lab Schedule:

	Lecture Date (Monday)	Lecture topics	Labs assigned	Lab due (at the beginning of the lab)
Week 1	Sept. 11	Introduction to the course/ 1. Introduction to remote sensing		
			Lab #0	
Week 2	Sept. 18	1. Remote sensing foundations		
			Lab #1	
Week 3	Sept. 25	2. Aerial photographs and photogrammetry		
			Lab #1	
Week 4	Oct. 2	2. Aerial photographs and photogrammetry		
			Lab #2	Lab#1 due
Week 5	Oct. 9	Thanks giving holiday/**Reading week**, no lectures		
Week 6	Oct. 16	3. Digital image processing– image enhancement		
			Lab #3	Lab#2 due
Week 7	Oct. 23	Midterm test - October 23		
			Lab #4	Lab #3 due
Week 8	October 30	4. Digital image processing – image classification		
			Lab #5	Lab #4 due
Week 9	Nov. 6	4. Digital image processing – image classification		
			Lab #6	Lab #5 due
Week 10	Nov. 13	5. Remote sensing image interpretation		
			Lab #6	
Week 11	Nov. 20	6. Remote sensing applications and case studies; Invited presentations		
				Lab#6 due
Week 12	Nov. 27	Student presentations		
Week 13	Dec. 4	Student presentations		

Last day of class: Dec. 8, 2017.